Biomolecular Motor Transport
(Hancock, Jackson, Horn, Catchmark and Williams, IRG 2)
To harness the microscale transport and force generating capabilities of biological molecular motors, we are incorporating kinesin motor proteins and microtubules (25 nm protein polymer tracks) into microfabricated structures and devising novel approaches for labeling and cargo attachment. We have created microscale channels in SU-8 photoresist, immobilized kinesin motors in these channels, and transported microtubules along these defined tracks. We were the first group to adapt this photoresist for work with biomolecular motors, and this work sets out a fabrication strategy for creating three-dimensional structures to guide motor-driven microtubule transport. The eventual goal of this work is to isolate DNA fragments or cells and transport them to defined destinations on a microfluidic chip. We have successfully bound both DNA target molecules and white blood cels to the microtubules using the biotin-streptavidin system.

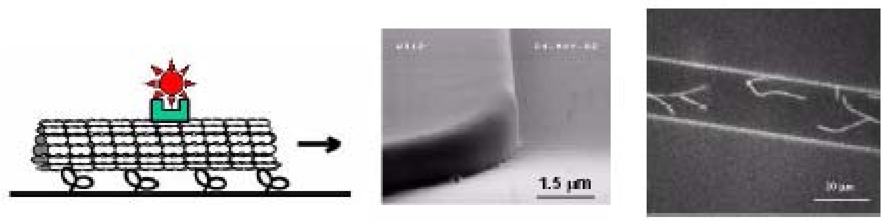
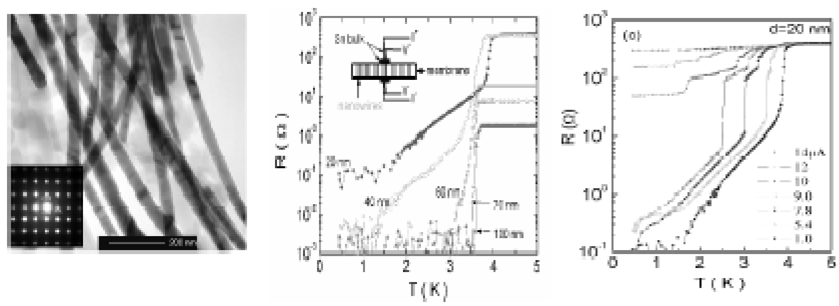


Figure 1: Kinesin-microtubule based transport. Motor proteins are immobilized on glass, microtubules carrying molecular or cellular cargo are transported along these motors. Channels made from SU-8 photoresist guide the direction of microtubule movement. Hence, the system offers an alternative to microfluidic transport that uses autonomous motors and localizes energy consumption to the site of transport.

Dissipation in one-dimensional superconductor
(Mingliang Tian, Jinguo Wang,, James Kurtz, Theresa Mayer, Ying Liu, Peter Schiffer, Thomas E. Mallouk and M.H.W.Chan, IRG 3))

The nature of dissipation in a one-dimensional (1D) superconductor below Tc is extensively debated in the last two decades. A major r eason for the uncertainties is the variety of microstructure and morphology of the samples. In order to eliminate the influence of sample morphology and to single out what is the intrinsic phenomena due to size confinement, we made a systematic study of the transport properties of single-crystal Sn nanowires with diameters of 20 - 100 nm and length prepared by a template-assembly technique. Our results show a clear crossover from bulk-like to 1d-like behavior when the diameter of the wires is reduced below 60 nm (4 times smaller than the bulk coherence length). Two different dissipative regimes, i.e., low current ìohmicî-like finite residual resistive dissipation and high current-induced step-like dissipative regime, are found.



Left panel, TEM image of 40 nm single-crystal Sn nanowires. **Middle panel,** resistance versus temperature of Sn nanowires with various diameters measured at low excitation current. **Right panel,** resistance versus temperature of 20 nm Sn nanowires measured at different excitation current.

Materials Matter: It's a Nanoworld After All

Through our partnership with Philadelphia's nationally renowned science museum The Franklin Institute, the museum show *Materials Matter: It's a Nanoworld After All* has been produced and distributed to 22 (roughly equal numbers of small, medium and large) science museums nationwide. Also provided are demonstrational materials and supplies to equip a show for a year at each museum. This 60-minute cart based interactive exploration has been viewed by an estimated 300,000 (many of them school-aged) visitors in 2003. The show includes demonstrations and macro-scale models that explore the "micro" mechanisms behind the unusual and surprising "macro" behavior of materials such as aerogels, shape-memory alloys, polymers, electronic ink, and zeolites. A CNS development team consisting of six graduate students and six faculty members worked with five members of the program development staff at The Franklin Institute to develop the show. Two copies of the show reside at Penn State and are used by CNS to present the show locally. We are currently working to produce a second museum show on nanotechnology, *Our Bodies: The Ultimate Nanotechnology Factory*, to be distributed in the fall of 2004.